Title: Kernel PLS Estimation of Single-trial Event-related Potentials
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Nonlinear kernel partial least squares (KPLS) regression is a novel smoothing approach to nonparametric regression curve fitting. We have developed a KPLS approach to the estimation of single-trial event related potentials (ERPs). For improved accuracy of estimation, we also developed a local KPLS method for situations in which there exists prior knowledge about the approximate latency of individual ERP components. To assess the utility of the KPLS approach, we compared non-local KPLS and local KPLS smoothing with other nonparametric signal processing and smoothing methods. In particular, we examined wavelet denoising, smoothing splines, and localized smoothing splines. We applied these methods to the estimation of simulated mixtures of human ERPs and ongoing electroencephalogram (EEG) activity using a dipole simulator (BESA). In this scenario we considered ongoing EEG to represent spatially and temporally correlated noise added to the ERPs. This simulation provided a reasonable but simplified model of real-world ERP measurements. For estimation of the simulated single-trial ERPs, local KPLS provided a level of accuracy that was comparable with or better than the other methods. We also applied the local KPLS method to the estimation of human ERPs recorded in an experiment on cognitive fatigue. For these data, the local KPLS method provided a clear improvement in visualization of single-trial ERPs as well as their averages. The local KPLS method may serve as a new alternative to the estimation of single-trial ERPs and improvement of ERP averages.